CLAIMS

1. Data processing apparatus for processing data objects and comprising:

a set of processing elements operable to perform respective processing tasks;

an operating environment receiving the processing elements in co-operable relationship;

a first channel defined by the operating environment and operatively connecting the processing elements in a sequence for communicating the data objects between successive processing elements in an order defined by the sequence;

a second channel defined by the operating environment for communicating a user interface control object between successive processing elements in the sequence;

and a user interface controller responsive to the user interface control object when output from a last processing element in the sequence to generate control data for controlling a user interface in use to present information to the user for controlling the processing elements.

2. Apparatus as claimed in claim 1 wherein each processing element is operable to edit the user interface

control object to add a respective component of the user interface control object.

3. Apparatus as claimed in claim 2 wherein at least one of the processing elements is operable to edit a component of the user interface control object corresponding to a preceding processing element in the sequence.

4. Apparatus as claimed in claim 3 wherein the control data generated by the user interface controller is for defining a display area of a graphical user interface within which information defined by each component is presented in a respective window.

5. Apparatus as claimed in claim 4 wherein the user interface controller is operable to generate the control data such that the respective windows are positioned in the display area in an order corresponding to the order of the sequence of processing elements in the operating environment.

6. Apparatus as claimed in claim 4 wherein the user interface controller is operable to generate the control data such that each window displays information defined

by a respective component identifying the respective processing element to thereby indicate in use to the user the identity of processing elements in the sequence within the operating environment.

7. Apparatus as claimed in claim 4 wherein the component of the user interface control object corresponding to at least one of the processing elements defines code for enabling the respective window to display control parameters for controlling the processing element.

8. Apparatus as claimed in claim 4 wherein the component of the user interface control object corresponding to at least one of the processing elements defines code for enabling the respective window to display data which is input via the user interface to the processing element.

9. Apparatus as claimed in claim 4 wherein the component of the user interface control object corresponding to at least one of the processing elements defines code for enabling the respective window to display a control button for selecting an operational mode of the processing element.

10. Apparatus as claimed in claim 4 wherein one of the processing elements is operable to perform a toolbar function of editing the user interface control object such that the components of preceding processing elements in the sequence are modified such that their respective windows are displayed in compressed form as a toolbar.

11. Apparatus as claimed in claim 4 wherein one of the processing elements in the sequence is a user interface processing element operable to edit the user interface control object but which is transparent to the data objects.

12. Apparatus as claimed in claim 3 wherein at least one of the processing elements is operable to selectively edit one or more components of the user interface control object in respect of preceding processing elements in the sequence so as to remove at least part of the information presented by their respective windows from the display area.

13. Apparatus as claimed in claim 1 comprising a system controller operable to select said processing elements from a library of processing elements and to load selected processing elements into the operating

environment in said sequence determined by the user.

14. Apparatus as claimed in claim 13 wherein the system comprises a memory and the controller is operable to store in said memory the set of processing elements as a customised application for subsequent reuse.

15. Apparatus as claimed in claim 13 comprising output means for outputting code defining an application defined by the set of processing elements for input in use to an external apparatus having a further operating environment within which the application is operable.

16. Apparatus as claimed in claim 1 in combination with a user interface defining a data display area for displaying representations of the data objects, a selector window for displaying a library of processing elements for user selection, and a processing element display window containing a representation of the selected processing elements.

17. Apparatus as claimed in claim 1 wherein at least one of the processing elements comprises means for adding control features to data objects communicated via the processing element, the control features comprising a

data specific user interface control object for causing a respective control icon to be displayed in registration with each displayed data object when the user interface comprises a graphical user interface.

18. Apparatus as claimed in claim 17 wherein the processing element for adding control features to data objects comprises means for performing a processing task in response to selection of the control icon.

19. Apparatus as claimed in claim 18 wherein the processing task comprises causing data contained in the data object to be printed.

20. Apparatus as claimed in claim 15 wherein the sequence of processing elements comprises an object generating processing element for generating a peripheral device control object defining a user interface for controlling a peripheral device to which the external apparatus is connected in use.

21. Apparatus as claimed in claim 20 wherein the object generating processing element is responsive to at least one data object defining attributes of the peripheral device to generate the peripheral device control object

such that it defines control data for controlling a user interface to present information to the user of the external device for controlling corresponding operating parameters of the peripheral device.

22. Apparatus as claimed in claim 1 wherein the user interface control object comprises a document written in a markup language.

23. A data processing method for processing data objects and comprising:

loading a set of processing elements operable to perform respective processing tasks into an operating environment receiving the processing elements in co-operable relationship;

using a first channel defined by the operating environment and operatively connecting the processing elements in a sequence to communicate the data objects between successive processing elements in an order defined by the sequence;

using a second channel defined by the operating environment to communicate a user interface control object between successive processing elements in the sequence;

and operating a user interface controller responsive

to the user interface control object when output from a last processing element in the sequence to generate control data controlling a user interface to present information to the user for controlling the processing elements.

24. A method as claimed in claim 23 wherein each processing element edits the user interface control object to add a respective component of the user interface control object.

25. A method as claimed in claim 24 wherein at least one of the processing elements edits a component of the user interface control object corresponding to a preceding processing element in the sequence.

26. A method as claimed in claim 25 wherein the control data generated by the user interface controller defines a display area of a graphical user interface within which information defined by each component is presented in a respective window.

27. A method as claimed in claim 26 wherein the user interface controller generates the control data such that the respective windows are positioned in the display area

in an order corresponding to the order of the sequence of processing elements in the operating environment.

28. A method as claimed in claim 26 wherein the user interface controller generates the control data such that each window displays information defined by a respective component identifying the respective processing element to thereby indicate to the user the identity of processing elements in the sequence within the operating environment.

29. A method as claimed in claim 26 wherein the component of the user interface control object corresponding to at least one of the processing elements defines code for enabling the respective window to display control parameters for controlling the processing element.

30. A method as claimed in claim 26 wherein the component of the user interface control object corresponding to at least one of the processing elements defines code for enabling the respective window to display data which is input via the user interface to the processing element.

31. A method as claimed in claim 26 wherein the component of the user interface control object corresponding to at least one of the processing elements defines code for enabling the respective window to display a control button for selecting an operational mode of the processing element.

32. A method as claimed in claim 26 wherein one of the processing elements performs a toolbar function of editing the user interface control object such that the components of preceding processing elements in the sequence are modified such that their respective windows are displayed in compressed form as a toolbar.

33. A method as claimed in claim 26 wherein one of the processing elements in the sequence is a user interface processing element which edits the user interface control object but which is transparent to the data objects.

34. A method as claimed in claim 25 wherein at least one of the processing elements selectively edits one or more components of the user interface control object in respect of preceding processing elements in the sequence so as to remove at least one part of the information presented by their respective windows from the display

area.

35. A method as claimed in claim 23 comprising a system controller which selects said processing elements from a library of processing elements and loads selected processing elements into the operating environment in said sequence determined by the user.

36. A method as claimed in claim 35 wherein the system comprises a memory and the controller stores in said memory the set of processing elements as a customised application for subsequent reuse.

37. A method as claimed in claim 35 comprising outputting code defining an application defined by the set of processing elements and inputting the code to an external apparatus having a further operating environment within which the application is operable.

38. A method as claimed in claim 23 wherein a user interface defines a data display area displaying representations of the data objects, a selector window for displaying a library of processing elements for user selection, and a processing element display window containing a representation of the selected processing

elements.

39. A method as claimed in claim 23 wherein at least one of the processing elements adds control features to data objects communicated via the processing element, the control features comprising a data specific user interface control object causing a respective control icon to be displayed in registration with each displayed data object when the user interface comprises a graphical user interface.

40. A method as claimed in claim 39 wherein the processing element adding control features to data objects performs a processing task in response to selection of the control icon.

41. A method as claimed in claim 40 wherein the processing task comprises causing data contained in the data object to be printed.

42. A method as claimed in claim 37 wherein the sequence of processing elements comprises an object generating processing element which generates a peripheral device control object defining a user interface for controlling a peripheral device to which the external apparatus is

connected in use.

43. A method as claimed in claim 42 wherein the object generating processing element responds to at least one data object defining attributes of the peripheral device to generate the peripheral device control object such that it defines control data controlling a user interface to present information to a user of the external device for controlling corresponding operating parameters of the peripheral device.

44. A method as claimed in claim 23 wherein the user interface control object comprises a document written in a markup language.

45. Data processing apparatus for processing data objects and comprising:

a set of processing elements operable to perform respective processing tasks;

an operating environment receiving the processing elements in co-operable relationship;

a first channel defined by the operating environment and operatively connecting the processing elements in a sequence for communicating the data objects between successive processing elements in an order defined by the

sequence;

at least one of the processing elements being operable to generate user interface output objects representative of respective data objects communicated via the sequence of processing elements;

a user interface controller responsive to the user interface output objects to generate presentation data for output to a user interface for presenting information representative of the data objects;

and wherein one of the processing elements in the sequence comprises a help object generator operable to generate a help object comprising a further user interface output object representative of help information whereby the user interface controller is responsive to the help object to generate presentation data containing said help information for assisting a user in controlling the processing elements.

46. Apparatus as claimed in claim 45 wherein the help object generator is selectively operable to generate the help object representative of help information in respect of the previous processing element in the sequence.

47. Apparatus as claimed in claim 45 wherein the help object generator is selectively operable to generate a

help object representative of help information in respect of all of the processing elements available to the user.

48. Apparatus as claimed in claim 47 wherein the user interface comprises a graphical user interface and wherein the user interface controller is operable to generate presentation data to represent help objects in respect of each of the preceding processing elements as respective icons, the user interface controller being responsive to user selection of a selected icon by generating presentation data containing help information for the processing element corresponding to the selected icon.

49. Apparatus as claimed in claim 45 wherein the help object generator comprises a parser for extracting information representative of attributes of data objects communicated via the processing element and wherein the help object generator is selectively operable to generate the help object to comprise help information relating to the attributes of the data objects.

50. Apparatus as claimed in claim 49 wherein the help object generator is operable to generate a help object for graphically representing the data flow through each

preceding element in the sequence.

51. Apparatus as claimed in claim 45 wherein the help object generator comprises adaptive processing means operable to determine the identity of the processing elements in the sequence and to access a knowledge base to determine, based on the identity of the processing elements, appropriate help information to include in the help object.

52. Apparatus as claimed in claim 45 comprising a system controller operable to select said processing elements from a library of processing elements and to load selected processing elements into the operating environment in said sequence determined by the user.

53. Apparatus as claimed in claim 52 wherein the system comprises a memory and the controller is operable to store in said memory the set of processing elements as a customised application for subsequent reuse.

54. Apparatus as claimed in claim 52 comprising output means for outputting code defining an application defined by the set of processing elements for input in use to an external apparatus having a further operating environment

within which the application is operable.

55. Apparatus as claimed in claim 45 in combination with a user interface defining a data display area for displaying representations of the data objects, a selector window for displaying a library of processing elements for user selection, and a processing element display window containing a representation of the selected processing elements.

56. A method of data processing apparatus for processing data objects comprising:

loading a set of processing elements operable to perform respective processing tasks into an operating environment receiving the processing elements in co-operable relationship;

using a first channel defined by the operating environment and operatively connecting the processing elements in a sequence to communicate the data objects between successive processing elements in an order defined by the sequence;

at least one of the processing elements generating user interface output objects representative of respective data objects communicated via the sequence of processing elements;

operating a user interface controller responsive to the user interface output objects to generate presentation data output to a user interface for presenting information representative of the data objects;

and wherein one of the processing elements in the sequence comprises a help object generator generating a help object comprising a further user interface output object representative of help information whereby the user interface controller is responsive to the help object to generate presentation data containing said help information for assisting a user in controlling the processing elements.

57. A method as claimed in claim 56 wherein the help object generator selectively generates the help object representative of help information in respect of the previous processing element in the sequence.

58. A method as claimed in claim 56 wherein the help object generator selectively generates a help object representative of help information in respect of all of the processing elements available to the user.

59. A method as claimed in claim 58 wherein the user

interface comprises a graphical user interface and wherein the user interface controller is operable to generate presentation data to represent help objects in respect of each of the preceding processing elements as respective icons, the user interface controller being responsive to user selection of a selected icon by generating presentation data containing help information for the processing element corresponding to the selected icon.

60. A method as claimed in claim 56 wherein the help object generator comprises a parser extracting information representative of attributes of data objects communicated via the processing element and wherein the help object generator selectively generates the help object to comprise help information relating to the attributes of the data objects.

61. A method as claimed in claim 60 wherein the help object generator generates a help object graphically representing the data flow through each preceding element in the sequence.

62. A method as claimed in claim 56 wherein the help object generator comprises adaptive processing means

determining the identity of the processing elements in the sequence and accesses a knowledge base to determine, based on the identity of the processing elements, appropriate help information to include in the help object.

63. A method as claimed in claim 56 comprising a system controller selecting said processing elements from a library of processing elements and loading selected processing elements into the operating environment in said sequence determined by the user.

64. A method as claimed in claim 63 wherein the system comprises a memory and the controller stores in said memory the set of processing elements as a customised application for subsequent reuse.

65. A method as claimed in claim 63 comprising outputting code defining an application defined by the set of processing elements and inputting the code to an external apparatus having a further operating environment within which the application is operable.

66. A method as claimed in claim 56 wherein a user interface defines a data display area displaying

representations of the data objects, a selector window for displaying a library of processing elements for user selection, and a processing element display window containing a representation of the selected processing elements.

67. Data processing apparatus for processing data objects and comprising:

a set of processing elements operable to perform respective processing tasks;

an operating environment receiving the processing elements in co-operable relationship;

a first channel defined by the operating environment and operatively connecting the processing elements in a sequence for communicating the data objects between successive processing elements in an order defined by the sequence;

and a control channel defined by the operating environment for communicating control objects for controlling the operation of one or more of the processing elements, the control channel being operable to communicate the control objects between at least some of the processing elements in a reverse order which is the reverse of the order defined by the sequence.

68. Apparatus as claimed in claim 67 wherein at least one of the processing elements comprises a memory for storing at least one data object.

69. Apparatus as claimed in claim 68 wherein the processing element comprises a first sub element having means for connection to the first channel carrying data objects and a second sub element having means for connection to the control channel carrying control objects;

wherein the memory is accessible to both the first and second sub elements to constitute a shared state.

70. Apparatus as claimed in claim 69 comprising a second channel defined by the operating environment for communicating a user interface control object between successive processing elements in the sequence; and

a user interface controller responsive to the user interface control object when output from the last processing element in the sequence to generate control data for controlling a user interface in use to present information to the user for controlling the processing elements.

71. Apparatus as claimed in claim 70 wherein the user

interface controller is responsive to inputs from the user interface in use to communicate user commands to the last processing element in the sequence.

72. Apparatus as claimed in claim 71 wherein the last processing element in the sequence is operable to generate the control objects, the second sub filter thereof being responsive to the inputs from the user interface to identify a data element of the data object stored in the last processing element and which is the subject of an editing command.

73. Apparatus as claimed in claim 72 wherein at least one of the processing elements is a data manipulating processing element responsive to the editing command to perform a manipulation task of editing a corresponding data object stored in the data manipulating processing element.

74. Apparatus as claimed in claim 70 wherein a first processing element in the sequence comprises a first sub element operable to import data objects from a file system and a second sub element operable to export an edited data object to be stored in the file system.

75. Apparatus as claimed in claim 74 wherein the second sub element is selectively operable to export the edited data object in response to a data saving command contained in a control object.

76. Apparatus as claimed in claim 67 wherein at least one of the processing elements is operable to perform an undo function and comprises means for generating a counter edit command to be communicated to a preceding processing element in the sequence so as to undo the effect on a data object of a previously processed edit command.

77. Apparatus as claimed in claim 67 wherein the sequence of processing elements constitutes a word processing application and wherein one of the processing elements is operable to perform a spell checking task upon data objects comprising text.

78. Apparatus as claimed in claim 67 comprising a system controller operable to select said processing elements from a library of processing elements and to load selected processing elements into the operating environment in said sequence determined by the user.

79. Apparatus as claimed in claim 78 wherein the system comprises a memory and the system controller is operable to store in said memory the set of processing elements as a customised application for subsequent reuse.

80. Apparatus as claimed in claim 78 comprising output means for outputting code defining an application defined by the set of processing elements for input in use to an external apparatus having a further operating environment within which the application is operable.

81. Apparatus as claimed in claim 67 in combination with a user interface defining a data display area for displaying representations of the data objects, a selector window for displaying a library of processing elements for user selection, and a processing element display window containing a representation of the selected processing elements.

82. A data processing method for processing data objects and comprising:

loading a set of processing elements operable to perform respective processing tasks into an operating environment receiving the processing elements in co-operable relationship;

using a first channel defined by the operating environment and operatively connecting the processing elements in a sequence to communicate the data objects between successive processing elements in an order defined by the sequence;

and using a control channel defined by the operating environment to communicate control objects for controlling the operation of one or more of the processing elements, the control channel communicating the control objects between at least some of the processing elements in a reverse order which is the reverse of the order defined by the sequence.

83. A method as claimed in claim 82 wherein at least one of the processing elements comprises a memory for storing at least one data object.

84. A method as claimed in claim 83 wherein the processing element comprises a first sub element connected to the first channel carrying data objects and a second sub element connected to the control channel carrying control objects;

wherein the memory is accessible to both the first and second sub elements to constitute a shared state.

85. A method as claimed in claim 84 comprising a second channel defined by the operating environment communicating a user interface control object between successive processing elements in the sequence; and

a user interface controller responding to the user interface control object output from the last processing element in the sequence to generate control data controlling a user interface to present information to the user for controlling the processing elements.

86. A method as claimed in claim 85 wherein the user interface controller is responsive to inputs from the user interface to communicate user commands to the last processing element in the sequence.

87. A method as claimed in claim 86 wherein the last processing element in the sequence generates the control objects, the second sub element thereof being responsive to the inputs from the user interface to identify a data element of the data object stored in the last processing element and which is the subject of an editing command.

88. A method as claimed in claim 87 wherein at least one of the processing elements is a data manipulating processing element responsive to the editing command to

perform a manipulation task of editing a corresponding data object stored in the data manipulating processing element.

89. A method as claimed in claim 85 wherein a first processing element in the sequence comprises a first sub element importing data objects from a file system and a second sub element exports an edited data object to be stored in the file system.

90. A method as claimed in claim 89 wherein the second sub element selectively exports the edited data object in response to receiving a data saving command contained in a control object.

91. A method as claimed in claim 82 wherein at least one of the processing elements performs an undo function and generates a counter edit command communicated to a preceding processing element in the sequence so as to undo the effect on a data object of a previously processed edit command.

92. A method as claimed in claim 82 wherein the sequence of processing elements constitutes a word processing application and wherein one of the processing elements

performs a spell checking task upon data objects comprising text.

93. A method as claimed in claim 82 comprising a system controller selecting said processing elements from a library of processing elements and loading the selected processing elements into the operating environment in said sequence determined by the user.

94. A method as claimed in claim 93 wherein the system comprises a memory and the system controller stores in said memory the set of processing elements as a customised application for subsequent reuse.

95. A method as claimed in claim 93 comprising outputting code defining an application defined by the set of processing elements and inputting the code to an external apparatus having a further operating environment within which the application is operable.

96. A method as claimed in claim 82 wherein a user interface defines a data display area displaying representations of the data objects, a selector window for displaying a library of processing elements for user selection, and a processing element display window

containing a representation of the selected processing elements.

97. A storage medium storing processor implementable instructions for controlling a processor to carry out the method of claim 23.

98. An electrical signal carrying processor implementable instructions for controlling a processor to carry out the method of claim 23.

99. A computer program comprising processor implementable instructions for carrying out a method as claimed in claim 23.

100. An application comprising processor implementable instructions obtained by carrying out a method as claimed in claim 23.

101. A storage medium storing processor implementable instructions for an application obtained by carrying out a method as claimed in claim 23.

102. An electrical signal carrying processor implementable instructions for an application obtained

by carrying out a method as claimed in claim 23.

103. A logic circuit embodying an algorithm for carrying out a method as claimed in claim 23.

104. A storage medium storing processor implementable instructions for controlling a processor to carry out the method of claim 56.

105. An electrical signal carrying processor implementable instructions for controlling a processor to carry out the method of claim 56.

106. A computer program comprising processor implementable instructions for carrying out a method as claimed in claim 56.

107. An application comprising processor implementable instructions obtained by carrying out a method as claimed in claim 56.

108. A storage medium storing processor implementable instructions for an application obtained by carrying out a method as claimed in claim 56.

109. An electrical signal carrying processor implementable instructions for an application obtained by carrying out a method as claimed in claim 56.

110. A logic circuit embodying an algorithm for carrying out a method as claimed in claim 56.

111. A storage medium storing processor implementable instructions for controlling a processor to carry out the method of claim 82.

112. An electrical signal carrying processor implementable instructions for controlling a processor to carry out the method of claim 82.

113. A computer program comprising processor implementable instructions for carrying out a method as claimed in claim 82.

114. An application comprising processor implementable instructions obtained by carrying out a method as claimed in claim 82.

115. A storage medium storing processor implementable instructions for an application obtained by carrying out

a method as claimed in claim 82.

116. An electrical signal carrying processor implementable instructions for an application obtained by carrying out a method as claimed in claim 82.

117. A logic circuit embodying an algorithm for carrying out a method as claimed in claim 82.